

**What is claimed is:**

1. A method of limiting reuse of domain name information, the method comprising the steps of:

requesting domain name information from an authoritative domain name server; and

providing the domain name information to a local domain name server in response to the request, the domain name information comprising an allowable usage limit, the allowable usage limit representing a maximum number of times that the domain name information may be provided to at least one requestor before validating the domain name information.

2. A method of limiting reuse of domain name information as defined by Claim 1, further comprising the steps of:

receiving a request for the domain name information from the at least one requestor;

determining whether the domain name information is stored in memory; and  
requesting the domain name information by the local domain name server from the authoritative domain name server in response to the domain name information not being stored in memory.

3. A method of limiting reuse of domain name information as defined by Claim 1, further comprising the step of determining whether a time-to-live threshold associated with the domain name information has expired, the domain name information being requested from the authoritative domain name server in response to the time-to-live threshold being expired.

4. A method of limiting reuse of domain name information as defined by Claim 1, wherein the domain name information comprises a hostname-to-internet protocol address mapping.

5. A method of limiting reuse of domain name information as defined by Claim 1, wherein the at least one requestor comprises at least one of a client and a server.

6. A method of limiting reuse of domain name information as defined by Claim 1,

the method further comprising the steps of:

initializing a residual usage counter to the allowable usage limit;  
providing the domain name information to the at least one requestor; and  
decrementing the residual usage counter to represent the domain name  
information being provided to the at least one requestor.

7. A method of limiting reuse of domain name information as defined by Claim 6, wherein the step of providing the domain name information to the at least one requestor further comprises the step of providing the domain name information and an allowable usage limit subset M to a server, and the step of decrementing the residual usage counter further comprises the step of decrementing the residual usage counter by M, where M is an integer being one of less than the residual usage counter and equal to the residual usage counter.

8. A method of limiting reuse of domain name information as defined by Claim 6, further comprising the steps of:

determining whether the residual usage counter has expired; and  
requesting the domain name information in response to the residual usage counter being expired.

9. A method of limiting reuse of domain name information as defined by Claim 1, further comprising the steps of;

determining whether the residual usage counter has expired;  
providing the domain name information to the at least one requestor in response to the residual usage counter not being expired; and  
decrementing the residual usage counter in response to the residual usage counter not being expired.

10. A method of limiting reuse of domain name information as defined by Claim 9, wherein the step of providing the domain name information to the at least one requestor further comprises the step of providing the domain name information and an allowable usage limit subset M to a server, and the step of decrementing the residual usage counter further comprises the step of decrementing the residual usage counter by M, where M is an integer being one of less than the residual usage counter and equal to the residual usage counter.

11. A method of limiting reuse of domain name information as defined by Claim 1, the method further comprising the steps of:

initializing an observed usage counter; and  
incrementing the observed usage counter to represent the domain name information being provided to the at least one requestor.

12. A method of limiting reuse of domain name information as defined by Claim 11, the method further comprising the step of providing a value of the observed usage counter to the authoritative domain name server.

13. A method of limiting reuse of domain name information as defined by Claim 1, wherein the domain name information comprises a hostname-to-internet protocol address mapping, the mapping including at least one hostname mapped to a plurality of internet protocol addresses, the method further comprising the steps of:

assigning at least one allowable usage limit to each of the plurality of internet protocol addresses; and  
assigning at least one of the plurality of internet protocol addresses to the at least one requestor in accordance with a round-robin manner.

14. A method of limiting reuse of domain name information as defined by Claim 1, wherein the domain name information comprises a hostname-to-internet protocol address mapping, the mapping including at least one hostname mapped to a plurality of internet protocol addresses, the method further comprising the steps of;

assigning at least one allowable usage limit to each of the plurality of internet protocol addresses; and  
assigning at least one of the plurality of internet protocol addresses probabilistically to the at least one requestor in accordance with a weighting associated with the each of the plurality of internet protocol addresses.

15. A method of limiting reuse of domain name information, the method comprising the steps of:

receiving a request for domain name information from a lower-level server;  
requesting the domain name information by a mid-level server from an upper-level server in response to receiving the request from the lower-level server; and

providing the domain name information by the mid-level server, the domain name information comprising an allowable usage limit, the allowable usage limit representing a maximum number of times that the domain name information may be provided to at least one requestor before validating the domain name information.

16. A method of limiting reuse of domain name information as defined by Claim 15, wherein the request from the lower-level server comprises an allowable usage limit previously granted to the lower-level server  $N_L$ , a lower bound of usage observed by the lower-level server  $O_{L,LOW}$ , and an upper bound of usage observed by the lower-level server  $O_{L,HIGH}$ .

17. A method of limiting reuse of domain name information as defined by Claim 16, wherein the request for the domain name information to the upper-level server comprises an allowable usage limit observed by the mid-level server  $N_M$ , a lower bound of usage observed by the mid-level server  $O_{M,LOW}$ , and an upper bound of usage observed by the mid-level server  $O_{M,HIGH}$ .

18. A method of limiting reuse of domain name information as defined by Claim 15, further comprising the steps of:

receiving a request for the domain name information from the lower-level server;

determining whether the domain name information is stored in memory; and requesting the domain name information by the mid-level server from the upper-level server in response to the domain name information not being stored in memory.

19. A method of limiting reuse of domain name information as defined by Claim 15, further comprising the step of determining whether a time-to-live threshold associated with the domain name information has expired, the domain name information being requested from the upper-level server in response to the time-to-live threshold being expired.

20. A method of limiting reuse of domain name information as defined by Claim 15, wherein the domain name information comprises a hostname-to-internet protocol address mapping.

21. A method of limiting reuse of domain name information as defined by Claim 15, wherein the domain name information comprises a time-to-live threshold, the time-to-live threshold representing a maximum time that the domain name information may exist before validating the domain name information.
22. A method of limiting reuse of domain name information as defined by Claim 15, wherein the at least one requestor comprises at least one of a client and a server.
23. A method of limiting reuse of domain name information as defined by Claim 17, the method further comprising the steps of:
  - determining whether the residual usage counter has expired;
  - requesting the domain name information in response to the residual usage counter being expired;
  - initializing a residual usage counter to the allowable usage limit;
  - initializing a lower bound of usage observed by the mid-level server  $O_{M,LOW}$  and an upper bound of usage observed by the mid-level server  $O_{M,HIGH}$  to zero;
  - decrementing the residual usage counter by  $N_{RESP}$  to represent the domain name information being provided to the lower-level server, where  $N_{RESP}$  is a non-negative integer being one of less than the residual usage counter and equal to the residual usage counter;
  - incrementing  $O_{M,LOW}$  by one;
  - incrementing  $O_{M,HIGH}$  by  $N_{RESP}$ ; and
  - providing the domain name information and the allowable usage limit subset  $N_{RESP}$  to the lower-level server.
24. A method of limiting reuse of domain name information as defined by Claim 23, further comprising the steps of:
  - decrementing  $O_{M,LOW}$  by one and adding  $O_{L,LOW}$  in response to the residual usage counter not being expired;
  - decrementing  $O_{M,HIGH}$  by  $N_L$  and adding  $O_{L,HIGH}$  in response to the residual usage counter not being expired;
  - incrementing the residual usage counter by  $N_L$  and subtracting  $O_{L,HIGH}$  in response to the residual usage counter not being expired;

providing the domain name information and the allowable usage limit subset  $N_{RESP}$  to the lower-level server in response to the residual usage counter not being expired;

decrementing the residual usage counter by  $N_{RESP}$  in response to the residual usage counter not being expired;

incrementing  $O_{M,LOW}$  by one; and

incrementing  $O_{M,HIGH}$  by  $N_{RESP}$  to represent the domain name information being provided to the lower-level server.

25. A system for limiting reuse of domain name information, the system comprising:

an authoritative domain name server;

a local domain name server, the local domain name server being operatively coupled to the authoritative domain name server; and

at least one requestor, the at least one requestor being operatively coupled to the local domain name server, the at least one requestor requesting domain name information from the local domain name server, the local domain name server requesting domain name information from the authoritative domain name server in response to the at least one requestor requesting domain name information, the authoritative domain name server providing the domain name information in response to the local domain name server requesting domain name information, the domain name information including an allowable usage limit, the allowable usage limit representing a maximum number of times the domain name information may be provided to at least one requestor before validating the domain name information.

26. A system for limiting reuse of domain name information as defined by Claim 25, wherein the local domain name server determines whether the domain name information is stored in memory, the domain name information being requested from the authoritative domain name server in response to the local domain name server determining that the domain name information is not stored in memory.

27. A system for limiting reuse of domain name information as defined by Claim 25, the local domain name server determining whether a time-to-live threshold associated with the domain name information has expired, the time-to-live threshold representing a maximum time that the domain name information may exist before

validating the domain name information, the domain name information being requested from the authoritative domain name server in response to the time-to-live threshold being expired.

28. A system for limiting reuse of domain name information as defined by Claim 25, wherein the domain name information comprises a hostname-to-internet protocol address mapping.

29. A system for limiting reuse of domain name information as defined by Claim 25, wherein the at least one requestor comprises at least one of a client and a server.

30. A system for limiting reuse of domain name information as defined by Claim 25, wherein the local domain name server initializes a residual usage counter value to the allowable usage limit, the local domain name server decrementing the residual usage counter value to represent the domain name information being provided to the at least one requestor.

31. A system for limiting reuse of domain name information as defined by Claim 30, wherein the local domain name server provides the domain name information and an allowable usage limit subset  $M$  to the at least one requestor, the local domain name server decrementing the residual usage counter by  $M$ , where  $M$  is a non-negative integer being one of less than the residual usage counter and equal to the residual usage counter.

32. A system for limiting reuse of domain name information as defined by Claim 30, wherein the local domain name server determines whether the residual usage counter has expired, the domain name information being requested from the authoritative domain name server in response to the residual usage counter being expired.

33. A system for limiting reuse of domain name information as defined by Claim 25, wherein the local domain name server determines whether the residual usage counter has expired, the local domain name server decrementing the residual usage counter in response to the residual usage counter not being expired, the local

domain name server providing the domain name information to the at least one requestor in response to the residual usage counter not being expired.

34. A system for limiting reuse of domain name information as defined by Claim 25, wherein the local domain name server provides the domain name information and an allowable usage limit subset M to the at least one requestor, the local domain name server decrementing the residual usage counter by M, where M is a non-negative integer being one of less than the residual usage counter and equal to the residual usage counter.

35. A system for limiting reuse of domain name information as defined by Claim 25, wherein the local domain name server initializes an observed usage counter, the local domain name server incrementing the observed usage counter to represent the domain name information being provided to the at least one requestor.

36. A system for limiting reuse of domain name information as defined by Claim 35, wherein the local domain name server provides the observed usage counter value to the authoritative domain name server.

37. A system for limiting reuse of domain name information as defined by Claim 25, wherein the domain name information comprises a hostname-to-internet protocol address mapping, the mapping including at least one hostname mapped to a plurality of internet protocol addresses, the local domain name server assigning at least one allowable usage limit to each of the plurality of internet protocol addresses, the local domain name server assigning at least one of the plurality of internet protocol addresses to the at least one requestor in accordance with a round-robin manner.

38. A system for limiting reuse of domain name information as defined by Claim 25, wherein the domain name information comprises a hostname-to-internet protocol address mapping, the mapping including at least one hostname mapped to a plurality of internet protocol addresses, the local domain name server assigning at least one allowable usage limit to each of the plurality of internet protocol addresses, the local domain name server assigning at least one of the plurality of internet protocol addresses probabilistically to the at least one requestor in accordance with

a weighting associated with each of the plurality of internet protocol addresses.

39. A system for limiting reuse of domain name information, the system comprising the steps of:

an upper-level server;

a mid-level server, the mid-level server being operatively coupled to the upper-level server;

a lower-level server, the lower-level server being operatively coupled to the mid-level server, the mid-level server receiving a request for domain name information from the lower-level server, the mid-level server requesting the domain name information from the upper-level server in response to receiving the request from the lower-level server, the mid-level server providing the domain name information comprising an allowable usage limit to the lower-level server, the allowable usage limit representing a maximum number of times that the domain name information may be provided to at least one requestor before validating the domain name information.

40. A system for limiting reuse of domain name information as defined by Claim 39, wherein the request from the lower-level server comprises an allowable usage limit previously granted to the lower-level server  $N_L$ , a lower bound of usage observed by the lower-level server  $O_{L,LOW}$ , and an upper bound of usage observed by the lower-level server  $O_{L,HIGH}$ .

41. A system for limiting reuse of domain name information as defined by Claim 40, wherein the request for the domain name information to the upper-level server comprises an allowable usage limit stored in the mid-level server  $N_M$ , a lower bound of usage observed by the mid-level server  $O_{M,LOW}$ , and an upper bound of usage observed by the mid-level server  $O_{M,HIGH}$ .

42. A system for limiting reuse of domain name information as defined by Claim 39, wherein the mid-level server determines whether the domain name information is stored in memory in the mid-level server, the domain name information being requested by the mid-level server from the upper-level server in response to receiving the request from the lower-level server and the domain name information not being stored in memory.

43. A system for limiting reuse of domain name information as defined by Claim 39, wherein the mid-level server determines whether a time-to-live threshold associated with the domain name information has expired, the domain name information being requested from the upper-level server in response to the time-to-live threshold being expired.
44. A system for limiting reuse of domain name information as defined by Claim 39, wherein the domain name information comprises a hostname-to-internet protocol address mapping.
45. A system for limiting reuse of domain name information as defined by Claim 39, wherein the domain name information comprises a time-to-live threshold, the time-to-live threshold representing a maximum time that the domain name information may exist before validating the domain name information.
46. A system for limiting reuse of domain name information as defined by Claim 39, wherein the at least one requestor comprises at least one of a client and a server.
47. A system for limiting reuse of domain name information as defined by Claim 41, wherein the mid-level server determines whether the residual usage counter has expired, the mid-level server requesting the domain name information in response to the residual usage counter being expired, the mid-level server initializing a residual usage counter to the allowable usage limit, the mid-level server initializing a lower bound of usage observed by the mid-level server  $O_{M,LOW}$  and an upper bound of usage observed by the mid-level server  $O_{M,HIGH}$  to zero, the mid-level server decrementing the residual usage counter by  $N_{RESP}$  to represent the domain name information being provided to the lower-level server, where  $N_{RESP}$  is a non-negative integer being one of less than the residual usage counter and equal to the residual usage counter, the mid-level server incrementing  $O_{M,LOW}$  by one, the mid-level server incrementing  $O_{M,HIGH}$  by  $N_{RESP}$ , the mid-level server providing the domain name information and the allowable usage limit subset  $N_{RESP}$  to the lower-level server.

48. A system for limiting reuse of domain name information as defined by Claim 47, wherein the mid-level server decrements  $O_{M,LOW}$  by one and adds  $O_{L,LOW}$  in response to the residual usage counter not being expired, the mid-level server decrementing  $O_{M,HIGH}$  by  $N_L$  and adding  $O_{L,HIGH}$  in response to the residual usage counter not being expired, the mid-level server incrementing the residual usage counter by  $N_L$  and subtracting  $O_{L,HIGH}$  in response to the residual usage counter not being expired, the mid-level server providing the domain name information and the allowable usage limit subset  $N_{RESP}$  to the lower-level server in response to the residual usage counter not being expired, the mid-level server decrementing the residual usage counter by  $N_{RESP}$  in response to the residual usage counter not being expired, the mid-level server incrementing  $O_{M,LOW}$  by one, the mid-level server incrementing  $O_{M,HIGH}$  by  $N_{RESP}$  to represent the domain name information being provided to the lower-level server.